Operating Systems

Team Project Assignment
(Worth 30%)

A Study of the Synchronisation and Concurrency Issues in the Dining Philosophers' Problem completed using the ThreadMentor Visualisation Tool

Dr. Kevin Farrell
eMail: kevin.farrell@tudublin.ie

24th January 2022

Table of Contents

1. Objectives

You are required to work in teams of about **five** people.

The project problem is to study, using the ThreadMentor software tool, the synchronisation and concurrency issues arising in a programmed solution to the Dining Philosophers problem. The ThreadMentor e-book website is available at:

https://www.cs.mtu.edu/~shene/NSF-3/e-Book/

Put simply, the project problem is to study a running program, called the Dining Philosophers problem, which has multiple threads, and to understand how those threads are made/coded to take it in turns to access shared resources.

2. Tasks Required

The main tasks required by you and your team are given below. One of your overarching tasks is to learn how to do these as you progress through the semester. You are not expected to know how to do them at the start:

- Learn about C++, ThreadMentor and the Dining Philosophers problem. Then, study and understand the coded solutions provided on the ThreadMentor e-book website.
- There are **two** categories of solution to the Dining Philosophers problem presented on the ThreadMentor e-book website. There may be several different solutions provided in each category. You should read about **ALL** of these solutions, and then choose **ONE** to study. The categories are as follows:
  - Mutual Exclusion Locks
  - Semaphores
- Download the Dining Philosophers problem-code given on the ThreadMentor e-book website. Compile the code, and run the resulting program using the ThreadMentor visualisation tool, analysing the code at various steps in its execution.
- For your chosen solution, give a presentation, outlining your proposal. Also, give a mid-semester progress presentation, write a final report and give a final presentation/demonstration discussing the synchronisation and concurrency issues

in the execution of the programmed solution. As part of your discussion, your report **and** presentation should contain a description of sequences of screenshots of the visualised execution, accompanied by corresponding source code fragments. Therefore, when running the program(s), it is important to take appropriate ThreadMentor screenshots and code snapshots, so that they can be included in your report. You can use the **ksnapshot** or **spectacle** tool for this.

- **Note**: the sequence of screenshots you finally use in your presentation and report must be obtained during a single run of the program, since the program behaviour is different each time you run it.

3. Deliverables

There are **four deliverables for this project**, as follows.

3.1 Project Proposal

Prepare a project proposal *document*, and give a brief online powerpoint-style presentation in the practical session, two weeks after the beginning of the semester. The presentation should be **3 minutes maximum**. You need to upload the project proposal *document* to moodle.

You should **very briefly** describe the problem that you're going to study, namely the Dining Philosophers Problem. Then, state in a few slides:

- ***What*** solution you are proposing to study
- ***Why*** you chose that solution
- ***How*** you are going to study it, including a project plan. A good way to show the project plan is to create a **realistic** Gantt chart; i.e. one that you think would *actually* be useful to you in planning out your project. I'm not interested in seeing a Gantt chart for the sake of it. So, please don't include a Gantt chart just because "Kevin wants one"!!!! If you have a better way of showing your plan, by all means, use it. A brief verbal description of the various elements in your plan would also be good, within the time limit.

Please bear in mind, that the presentation must be brief: 3 minutes **maximum**.

3.2 Mid-Semester Project Progress Presentation

Give a mid-semester online team presentation on the progress of your project of **5 minutes maximum** – **see notes below.**

3.3 Team Report

Write a Team report (5,000 words maximum), which must:

1. Contain a list of **every member** on your team (student number and full name) on the title page. Only those members who contributed to the project and report should be listed. As a team member, you should be fully familiar with the entire report and all aspects of the project – not just the sections you wrote and worked on!
2. Contain the following declaration: (**Note**: failure to include the declaration will result in a **zero** mark for the report):
   "We are aware of the University policy on plagiarism in assignments and examinations (3AS08). We understand that plagiarism, collusion, and copying are grave and serious offences in the University and we will accept the penalties that could be imposed if we engage in any such activity. This assignment, or any part of it, has not been previously submitted by us or any other person for assessment on this or any other course of study. We declare that this material, which we now submit for assessment, is entirely of our own work and has not been taken from the work of others, save and to the extent that such work has been cited and acknowledged within the text of our work."
3. Be a document, in either .docx, ODT or PDF format, and be named in accordance with the following naming rule:

   Surname1_Surname2_Surname3_Surname4_OS2021.odt
4. Contain proper referencing/citation. All sources used for both text and diagrams **must** be referenced/cited **within the body** of your report, with the list of references provided at the end of the document; this also includes websites[1]. If you don't understand what this means, it is your responsibility to ask me. The library website also has useful information on how to reference/cite correctly. **Note**: the inclusion,

1 Please do not use Wikipedia as a reference; instead, if you do use Wikipedia as an information source, please go to the original references cited within those Wikipedia pages.

without proper citation, whether intentionally or unintentionally, of material belonging to others is plagiarism. Reports that do not cite correctly may attract a **zero or near-zero mark** depending on the severity of the plagiarism. In cases, where a team of students allows their work to be plagiarised by others, the students allowing the plagiarism may also receive a **zero or near-zero mark**. In addition, cases of plagiarism may be processed through the University's Plagiarism procedures, with the possibility of a record being kept by the Department of Informatics of the incident and of the identities of the students involved.

5. Be typed with a spacing of at least one and a half. Each student is advised to retain an additional hard-copy for future study.
6. Be uploaded by **one member only** of each team to moodle (the link will be provided nearer the deadline). We currently use the Urkund antiplagiarism system. So you are permitted a **one-time only** upload. You will **not** be permitted to upload a "draft" version and then a "final" version later. This will be strictly enforced. So, please make sure that all members of your team are happy with your report before you upload it. **The deadline for uploads is the day of your practical session in Week 12; i.e. your practical session in the week beginning 26th April 2021 - see notes below.**

3.4 Project Presentation and Demonstration

Give a **10 minute** online presentation on the project in your practical session in Week 12; to include a demonstration and verbal description of the running program if requested by me.

Please DO NOT spend time in your presentation giving a general explanation of what the Dining Philosophers problem is. We will all know what it is by that stage! You will lose marks if you do this. A copy of your team's presentation must also be uploaded by **one member only** to a link on moodle prior to the practical session – **see notes below.**

Note: Each team will also be asked questions on their project at the end of their presentation. This is an essential part of the assessment.

4. Grading

This project will be awarded a total of **30%** of the marks for the Operating Systems module divided as follows:

Description	**% points**
Project Proposal + Brief Presentation	5%
Mid-Semester Presentation	5%
End of Semester Presentation/Demonstration and Team Report Marks generally divided equally; i.e. 10% points for the presentation/demonstration, 10% points for the Team report.	20%
Project Total	**30%**

I reserve the right to require additional interim deliverables from all teams in advance of the final deadline. Where such requirements occur, the marks to be allocated to these will be notified in advance. Grading of team members will be equal, except in circumstances where it becomes apparent that some team members are not contributing adequately. **In particular, see the notes below.**

Notes:

1. All presentations will be followed by questions from me. These questions will generally relate to the content of your team's presentation and project and your team's and individual's wider knowledge and understanding of OS concepts related to the project. The duration of questioning is dependent on the quality of the presentation. As a rule of thumb, presentations which are of a high standard usually involve a shorter questioning period. **Please note**: the purpose of asking you questions is not to 'catch you out' or to make you feel uncomfortable. It is to try to assess your level of involvement and work contributed to the project by you and your team so that you can be awarded a fair grade.
2. It is a **requirement** of the Project that your team take part in the presentation/demonstration at the end of the semester. This is so that I can verify that the project work is your own work – this is where the questioning comes in. Unless there is a really good reason, I will not accept Project Reports where the entire team has not undertaken the presentation/demonstration, and your team will

consequently score 0/20 for that part of the project.

3. Similarly, if any individual fails to take part in the presentation/demonstration without good reason (for e.g.: certified medical reasons, family illness or bereavement, etc.), he/she will score 0/20 for **both** the presentation/demonstration **and** the report. This is for the same reasons as above; i.e. the presentation and subsequent questioning is used to help verify that your individual contribution to the project work is your own work. The remaining members of the team will be graded as normal.

The following are **guidelines** of the criteria to be used for grading each project:

- Research: demonstrating that you have engaged in a reasonably broad and in-depth research of the project subject.
- Understanding and discussion of topic: demonstrating in your presentation and report that you understand the subject, **and** that you are able to discuss it using appropriate **technical** language.
- Originality: showing an interesting original approach.
- Professional style in both presentation and report: Use of title page, tables of contents and figures, consistent styles, page numbers, etc.
- Adherence to word limit in the report: being brief is just as much a skill as being able to waffle!
- Inclusion and proper use of references in both report and presentation: You must provide citations **within the body** of your report and presentation. Please **do not** use Wikipedia as a reference; instead, if you do use Wikipedia as an information source, please go to the original references cited within those Wikipedia pages, read them, and then cite them in your document.

5. Team Difficulties: Interpersonal Issues, Members not Working, etc.

If there are difficulties with members in a team not getting along or not pulling their weight, please let me know by email **as early as possible** in the project so that we can meet to try to resolve the issues. In my experience, early discussion around issues often solves them. Please **DO NOT** wait until the week before the project report and presentation are due, to

ask me for assistance as there will be little I can do at that stage to help resolve matters. E-mail: kevin.farrell@tudublin.ie

6. Questions?

If you have questions or if some aspect of the project is unclear, please post your question to the Q&A Forum, or ask me in class.